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14. ABSTRACT

Purpose: To examine change in physical fitness and body composition after a military deployment to Afghanistan. Methods: One hundred and ten infantry soldiers were measured before and after a 9-month deployment to Afghanistan for Operation Enduring Freedom. Measurements included treadmill peak oxygen uptake (peak VO2), lifting strength, medicine ball put, vertical jump, and body composition estimated via dual-energy x-ray absorptiometry (percent body fat), absolute body fat, fat-free mass, bone mineral content, and bone mineral density. Results: There were significant decreases ($P < 0.01$) in peak VO2 (-4.5%), medicine ball put (-4.9%0, body mass (-1.9%), and fat-free mass (-3.5%), whereas percent body fat increased from 17.7% to 19.6%. Lifting strength and vertical jump performance did not change predeployment to postdeployment. Conclusions: Nine months deployment to Afghanistan negatively affected aerobic capacity, upper body power, and body composition. The predeployment to postdeployment changes were not large and unlikely to present a major health or fitness concern. If deployments continue to be extended and time between deployments decreased, the effects may be magnified and further study warranted.

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aerobic fitness; military deployment, muscle strength, muscle power

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Physical Fitness and Body Composition after a 9-Month Deployment to Afghanistan

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[1]US Army Research Institute of Environmental Medicine, Military Performance Division, Natick, MA; [2]US Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, MD; [3]United States Military Academy, Department of Behavioral Sciences and Leadership, West Point, NY; [4]Oklahoma University Health Science Center, College of Public Health Occupational Medicine, Oklahoma City, OK

ABSTRACT

SHARP, M. A., J. J. KNAPIK, L. A. WALKER, L. BURRELL, P. N. FRYKMAN, S. S. DARAKJY, M. E. LESTER, and R. E. MARIN. Physical Fitness and Body Composition after a 9-Month Deployment to Afghanistan. *Med. Sci. Sports Exerc.*, Vol. 40, No. 9, pp. 1687–1692, 2008. **Purpose:** To examine change in physical fitness and body composition after a military deployment to Afghanistan. **Methods:** One hundred and ten infantry soldiers were measured before and after a 9-month deployment to Afghanistan for Operation Enduring Freedom. Measurements included treadmill peak oxygen uptake (peak $\dot{V}O_2$), lifting strength, medicine ball put, vertical jump, and body composition estimated via dual-energy x-ray absorptiometry (percent body fat, absolute body fat, fat-free mass, bone mineral content, and bone mineral density). **Results:** There were significant decreases ($P < 0.01$) in peak $\dot{V}O_2$ (−4.5%), medicine ball put (−4.9%), body mass (−1.9%), and fat-free mass (−3.5%), whereas percent body fat increased from 17.7% to 19.6%. Lifting strength and vertical jump performance did not change predeployment to postdeployment. **Conclusions:** Nine months deployment to Afghanistan negatively affected aerobic capacity, upper body power, and body composition. The predeployment to postdeployment changes were not large and unlikely to present a major health or fitness concern. If deployments continue to be extended and time between deployments decreased, the effects may be magnified and further study warranted. **Key Words:** AEROBIC FITNESS, MILITARY DEPLOYMENT, MUSCLE STRENGTH, MUSCLE POWER

Physical training is a job requirement for soldiers (5). Army physical training is designed to prepare a soldier for the physically demanding tasks performed during military operations. Although the need to maintain a state of physical readiness during military deployments is recognized, there is a lack of evidence regarding soldiers' ability to do so. Access to physical fitness facilities and training time may be limited during deployments and reductions in physical training may result in a loss of physical fitness. On the other hand, the physical requirements of the deployment (e.g., load bearing patrolling, convoys, preparing forward operating camps, lifting and carrying equipment) may offset some of the deleterious effects associated with the lack of scheduled exercise. The availability and type of food as well as the physical requirements of missions will greatly influence the changes in muscle and fat mass.

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There are no published studies describing the effects of a long-term land-based deployment on body composition and physical fitness in military personnel. Anecdotal reports from US combat unit leaders and health care providers suggest that soldiers returning from combat deployments exhibited decreased fat-free mass, muscle strength, and endurance. Loss of lean mass, muscle strength, and endurance could negatively affect mission performance and military readiness. These changes may also negatively affect performance during training and other missions, thus increasing the risk for injury upon redeployment.

The current study was conducted to quantify the effects of a 9-month deployment to Afghanistan on measures of physical fitness and body composition. Documenting changes in soldiers' physical readiness is the first step in the development and implementation of targeted programs to prevent or to mitigate potential degradation of fitness, health, and soldier readiness during deployment.

METHODS

This study was approved by the US Army Research Institute of Environmental Medicine Human Use Review Committee. After a briefing on the requirements and risks of the study, 135 soldiers volunteered to participate and signed a volunteer agreement. All were members of the 2nd

Battalion, 4th Infantry Regiment, 10th Mountain Division. Soldiers 35 yr old and older were medically screened (1). Soldiers were measured before and after deployment to Afghanistan. Predeployment measurements were made in January and February 2006, before the battalion's deployment in March 2006. Postdeployment measurements were made as soon as possible upon redeployment and took place during December 2006.

Soldiers reported for testing wearing standard Army physical fitness shorts, T-shirts, socks, and self-selected running shoes. The test battery was completed in approximately 3 h. Physical testing was not conducted in a standardized order; however, a station requiring minimal physical exertion (body composition or questionnaires) was interspersed between stations requiring greater physical exertion (muscle strength, treadmill running, and vertical jumping). To control for order effects, each soldier followed the same order of active events predeployment and postdeployment.

Height (cm) was measured using a stadiometer (Portable Height Rod, Seca Scales, Hamburg, Germany), and body weight (kg) was measured using a digital scale (Seca Alpha Model 770, Seca Scales) with subjects in physical training shirts, shorts, underclothes and socks. A Hologic model QDR 4500W Dual-Energy X-ray Absorptiometry (DXA) densitometer (Hologic Inc., Bedford, MA) was used for body composition analysis. Hologic software algorithms provided estimates of percent body fat, absolute body fat, total fat-free mass, bone mineral content, and bone mineral density. Soldiers were positioned supine on the DXA table with arms at their side. The feet were strapped together to maintain the correct position. The scanner head moved side to side across the body moving downward from head to toe. The precision of this measurement has been reported to be ±1% (3).

Lifting strength was measured using an incremental lifting machine. The test simulates lifting a box with handles from ground level onto the bed of a 5-ton military truck (175-cm final handle height). The weight carriage of the machine moves vertically between two guide rails. The weight carriage was accelerated upward by straightening the legs and pulling up on the handles until the load was pressed to the 175-cm mark on the vertical guides. The initial load was 18.2 kg and was increased in 9.0- or 4.5-kg increments until the soldier was unable or unwilling to complete the lift (19,21).

Lower body explosive power was measured with a vertical jump (8,13) using a Vertec™ device. Vertical jump height was recorded as the distance from standing reach height to peak jump height to the nearest 1.3 cm (0.5 inch).

Upper body explosive power was measured using a two-handed medicine ball put (similar to a basketball push-pass). The soldier sat in a chair placed against the wall, with his back pushed firmly against the chair back. A 2-kg medicine ball was held in both hands. The soldier touched his chest with the ball, paused, and pushed the medicine ball away as forcefully as possible. The final score was the average of the two furthest distances (cm) thrown (22).

Peak oxygen uptake (peak $\dot{V}O_2$) was measured using a continuous uphill treadmill running protocol (17,18). The soldier wore a mouthpiece connected by a flexible hose to a ParvoMedics TrueMax 2400 metabolic measurement system (Salt Lake City, UT), which monitored oxygen uptake. A Polar Heartwatch was used to monitor heart rate. A 5-min warm-up was run at 0% grade and 2.68 $m \cdot s^{-1}$ (6 mph). If the heart rate was less than 150 $beats \cdot min^{-1}$ by minute 5 of the warm-up, treadmill speed was increased to 3.13 $m \cdot s^{-1}$ (6.5 mph) for the remainder of the test. After the warm-up, the treadmill grade was increased by 2.5% every 3 min until voluntary exhaustion. The soldier was considered to be at peak $\dot{V}O_2$ if oxygen uptake did not increase by at least 2 $mL \cdot kg^{-1} \cdot min^{-1}$ 1 min after a grade increase. If the test was terminated due to volitional exhaustion or if a plateau in oxygen uptake was not achieved, criteria for assessing peak $\dot{V}O_2$ was (1) heart rate in excess of 90% age-predicted maximum heart rate and (2) respiratory exchange ratio in excess of 1.0 (14).

Soldiers were asked their age (yr) and birth date. Soldiers completed a questionnaire concerning their customary level of physical activity and provided self-ratings of four components of physical fitness (endurance, sprint speed, strength, and flexibility) (9). The predeployment questionnaire referred to the previous year, whereas the postdeployment questionnaire referred to the time deployed. The postdeployment questionnaire also contained questions involving deployment dates, locations, and exercise facilities and use.

Physical fitness and body composition changes from predeployment to postdeployment were analyzed using paired *t*-tests. ANCOVA were run to examine the effect of time between returning from deployment and testing on physical fitness and body composition. In addition, the soldiers were divided into quartiles for each measurement to determine whether segments of the population (highly fit, low body fat, etc.) were more affected by deployment than others. These data were analyzed via a two-way repeated-measures ANOVA using time (predeployment to postdeployment) and predeployment quartile grouping (Q1 [low score] − Q4 [high score]) in the analysis. Significant time-by-quartile interactions were further assessed using Tukey HSD *post hoc* tests. A Wilcoxon test was used to look at predeployment to postdeployment changes in the distribution of responses to self-assessed physical fitness on the questionnaire.

RESULTS

Of the 135 soldiers who completed predeployment testing, 14 soldiers did not complete postdeployment testing due to injury, illness, permanent change of station, temporary duty in other locations, or no-shows for testing. Soldiers did not all return from deployment on the same

TABLE 1. Body mass and composition changes from predeployment to postdeployment ($n = 110$).

	Predeployment (mean ± SD)	Postdeployment (mean ± SD)	Percent Change (%)[a]	t-test P value
Body mass (kg)	83.3 ± 14.7	81.7 ± 13.2	−1.8	0.01
Fat-free mass (kg)	62.8 ± 7.3	60.6 ± 6.9	−3.5	0.01
Body fat (%)	17.7 ± 6.4	19.5 ± 6.5	10.2	0.01
Body fat (kg)	15.1 ± 7.5	16.3 ± 7.5	7.9	0.01
Bone mineral content (g)	3550 ± 475	3423 ± 468	−3.6	0.01
Bone mineral density ($g \cdot cm^{-3}$)	1.31 ± 0.08	1.30 ± 0.08	−0.8	0.01

[a] (Post − Pre) / Pre × 100

day; therefore, the time between a soldier's return date and test date ranged from 5 to 209 d. The data from four volunteers were not used in any of the analyses, as they were deployed for less than 7 months (68, 82, 99, and 135 d). None of the soldiers who completed posttesting had any official medical limitations; however, if soldiers expressed concerns about performing a specific test, they were allowed to omit that test. Seven soldiers who reported for postdeployment testing were unwilling to perform two or more of the physical performance tests. These seven soldiers were eliminated from all analyses. Seven additional soldiers had some missing data but completed at least three of the four physically demanding tests. These data were included in the analyses for a final sample size of 110 soldiers.

The 110 soldiers included in the analyses were deployed 258 ± 18 d (mean ± SD), and the average time between redeployment and testing was 18 ± 14 d. The deployment times ranged from 208 d (7 months) to 318 d (10 months), but the majority of soldiers (89%) were deployed between 8 and 9 months.

At the predeployment measurement, the soldiers ranged in age from 18 to 43 yr, with a mean ± SD of 23.1 ± 4.7 yr. The height ranged from 160 to 201 cm, with a mean ± SD of 177.5 ± 6.7 cm. Body mass and composition are shown in Table 1. Body mass and fat-free mass decreased from predeployment to postdeployment, whereas percent body fat and fat mass increased from predeployment to postdeployment. There were also small decreases in bone mineral content and bone mineral density; however, the change in bone mineral density did not exceed the precision of the measurement tool (±1%).

The results of the predeployment and postdeployment physical fitness measurements are listed in Table 2. Performance on the medicine ball put and peak $\dot{V}O_2$ (absolute and relative to body mass) decreased from predeployment to postdeployment. There was no change in lifting strength or vertical jumping performance. A repeated-measures ANCOVA was conducted using the number of days between redeployment and testing as the covariate. The covariate did not reach statistical significance for any of the measures. This indicates that time lag between redeployment and testing did not have a strong influence on the changes in body composition or physical fitness measurements.

The repeated-measures ANOVA using predeployment quartiles as a grouping factor resulted in a significant time effect ($P < 0.01$) for peak $\dot{V}O_2$ (absolute and relative to body weight) and all the body composition variables. The time effect for medicine ball put was nearly significant ($P = 0.06$). Tukey *post hoc* analysis of the group effect revealed that each quartile was significantly different from every other quartile within each variable. The changes of greatest interest are the interaction effects between time and quartile group. There was a significant interaction effect for peak $\dot{V}O_2$, both absolute and relative to body weight ($P = 0.01$), medicine ball put ($P = 0.01$), vertical jump ($P = 0.01$), body mass ($P = 0.01$), fat-free mass ($P = 0.03$), percent body fat ($P = 0.04$), bone mineral content ($P = 0.01$), and bone mineral density ($P = 0.01$). Table 3 lists the predeployment to postdeployment percentage change by quartile group for variables with significant interaction effects and indicates the results of Tukey HSD *post hoc* tests. Soldiers who weighed more (Q4) predeployment tended to lose the most body mass postdeployment. Similarly, those with more fat-free mass (Q3 & Q4) predeployment lost the most fat-free mass postdeployment, although all quartiles tended to lose fat-free mass. Soldiers in the lowest quartile of percent body fat predeployment were the only group to significantly increase in percent body fat from predeployment to postdeployment, although all quartiles tended to increase in percent body fat. All soldiers tended to experience a decrease in bone mineral content from predeployment to postdeployment, but the difference was not significant in Q1. Soldiers with the highest bone mineral density (Q4) were the only group to decrease significantly postdeployment. Soldiers with the highest aerobic fitness predeployment (Q3 and Q4) tended to show the greatest decline in peak $\dot{V}O_2$ postdeployment. None of the within group

TABLE 2. Physical fitness measured predeployment and postdeployment.

		Predeployment (Mean ± SD)	Postdeployment (Mean ± SD)	Change (%)[a]	t-test P value
Cardiovascular ($n = 103$)	Peak $\dot{V}O_2$ ($L \cdot min^{-1}$)	4.22 ± 0.53	3.94 ± 0.50	−6.6	0.01
	Peak $\dot{V}O_2$ ($mL \cdot kg^{-1} \cdot min^{-1}$)	50.8 ± 6.1	48.5 ± 5.7	−4.5	0.01
Muscle power	Ball put (cm), ($n = 109$)	678.9 ± 80.4	645.4 ± 73.1	−4.9	0.01
	Vertical jump (cm), ($n = 110$)	51.2 ± 9.0	51.7 ± 8.3	1.0	0.34
Lifting strength (kg), ($n = 107$)		74.6 ± 12.9	74.6 ± 12.9	0.0	0.99

[a] Percent Change (%) = (Post − Pre) / Pre × 100.

TABLE 3. Percent change (%Δ = Post − Pre / Pre *100) in score from predeployment to postdeployment grouped by quartiles (Q1 = lowest, Q4 = highest).

	Q1 (%Δ)	Q2 (%Δ)	Q3 (%Δ)	Q4 (%Δ)
Body mass (n = 110)	0.0	0.2	−1.5	−5.0*
Fat-free mass (n = 110)	−2.6	−3.0**	−3.7*	−4.6*
Percent body fat (n = 110)	36.8*	11.8	4.0	9.9
Bone mineral content (n = 110)	−1.7	−3.6*	−4.5*	−3.9*
Bone mineral density (n = 110)	0.8	−0.8	−0.7	−1.4*
Peak VO_2 ($L{\cdot}min^{-1}$), (n = 103)	−3.9	−5.2*	−8.0*	−8.7*
Peak VO_2 ($mL{\cdot}kg^{-1}{\cdot}min^{-1}$), ($n$ = 103)	−3.4	−1.0	−4.5**	−8.8*
Lifting strength (n = 107)	6.9	−2.5	−0.6	−1.6
Medicine ball put (n = 110)	−1.3	−2.9	−4.8*	−9.4*
Vertical jump (n = 110)	10.5*	0.0	0.7	−5.3

Significant change predeployment to postdeployment within quartile group. * $P < 0.01$, ** $P < 0.05$.

predeployment to postdeployment changes in lifting strength reached the $P < 0.05$ level of significance. Soldiers in the lowest lifting strength quartile predeployment were the only group that tended to increase in strength postdeployment, which produced the significant group-by-time interaction. The lowest predeployment vertical jump quartile (Q1) increased postdeployment (P = 0.01), whereas the highest predeployment vertical jump quartile (Q4) decreased postdeployment (P = 0.06).

The frequency distribution of soldiers' self-ratings of physical fitness components is presented in Table 4. Compared with predeployment, soldiers reported lower self-ratings for each component of physical fitness after deployment. The mean percentage decrease (%change = post − pre / pre × 100) in self-rated physical fitness was −5.0%, −7.3%, −4.4%, and −5.4% for endurance, sprint speed, strength, and flexibility, respectively.

Nearly all soldiers reported that some form of training facility or equipment was available to them during their deployment (91% for aerobic equipment and 95% for strength training). Eighty-three percent reported using some form of aerobic equipment or facility such as treadmills, stationary bikes, or tracks. Eighty-five percent reported using strength training equipment such as free weights or weight-training machines. Treadmills were the aerobic training device most frequently available (81%), and 57% of soldiers reported using them. Free weights were available to 94% of soldiers, and 82% reported using them.

Soldiers were also asked to report the frequency (days per week) and duration (minutes per session) they performed aerobic exercise, strength training, or sports activities for 1 yr before and during deployment, and these data are in Table 5. Soldiers performed aerobic exercise at a lower frequency and duration during deployment than in the year before deployment. Predeployment, 80% of the soldiers performed aerobic exercise three or more days per week, whereas during deployment, the percentage was only 35%. In the year before deployment, 78% of soldiers performed aerobic exercise for more than 30 min per session, but during deployment this figure was only 57%. The responses to the frequency of strength training and sports activities were evenly divided between those reporting more and those reporting fewer days of those activity types, so no significant change was detected by the Wilcoxon analysis. Slightly more than half of the soldiers reported strength training for three or more days per week before (58%) and during (56%) deployment. Similar to aerobic training, the duration of strength training was reduced in that 74% of soldiers performed strength training for more than 30 min per session predeployment, whereas only 54% trained for more than 30 min per session during deployment. Only 11% and 8% of soldiers participated in sports three or more days per week before and during deployment, respectively. The majority participated in sports less than 1 $d{\cdot}wk^{-1}$ (65% before and 70% during deployment).

DISCUSSION

This study indicated that there were changes in physical fitness and body composition after a 9-month deployment to Afghanistan; however, these changes were not large. Aerobic power and upper body anaerobic power decreased approximately 5%, and it would be expected that these losses could rapidly be regained with systematic physical training (2,10). The decrease in aerobic power may have been due to the decrease in the frequency and duration of aerobic exercise participation as reported by the soldiers on the postdeployment questionnaire. Predeployment, participation in both aerobic and strength training exercise was similar to that reported by a group of nondeployed Army mechanics (16) and greater than that reported by basic combat trainees before entry into the Army (11). Nearly 70% of soldiers reported a decrease in the frequency of aerobic training during deployment. Access to training equipment during deployment apparently did not factor into the decision to train, as more than 90% reported having access to physical training equipment.

TABLE 4. Percentage distribution of self-ratings of endurance, sprint speed, strength, and flexibility predeployment and postdeployment (n = 108).

	Endurance		Sprint Speed		Strength		Flexibility	
	Predeployment	Postdeployment	Predeployment	Postdeployment	Predeployment	Postdeployment	Predeployment	Postdeployment
Far less than average	1.8	5.6	0.9	3.7	0.0	0.9	4.6	3.7
Less than average	13.6	16.7	10.9	18.5	5.5	11.1	20.2	25.0
Average	50.0	48.1	50.0	50.0	55.5	54.6	48.6	56.5
Greater than average	30.9	27.8	31.8	22.2	31.8	25.9	23.9	13.9
Far greater than average	3.6	1.9	6.4	5.6	7.3	7.4	2.8	0.9
Wilcoxon P value	0.05		0.01		0.03		0.05	

TABLE 5. Frequency distribution (% of sample responding) for frequency and duration of aerobic training, strength training, and sports participation before and during deployment.

	Aerobic Training			Strength Training			Sports Participation		
	Pre		During	Pre		During	Pre		During
Frequency (d·wk^{-1})									
None	0		13.0	0.9		6.5	40.9		39.8
<1	0		24.1	0.9		13.0	24.5		30.6
1	1.8		12.0	5.5		5.6	10.9		13.9
2	18.2		15.7	34.5		19.4	12.7		7.4
3	45.5		18.5	34.5		16.7	5.5		2.8
4	12.7		6.5	7.3		10.2	2.7		1.9
5	20.0		6.5	13.6		16.7	0.9		0.9
6–7	1.8		3.7	2.7		12.0	1.8		2.8
Wilcoxon *P* value		0.01			0.85			0.65	
Duration (min per session)	**Pre**		**Post**	**Pre**		**Post**	**Pre**		**Post**
None	0		15.7	[illegible]		6.5	39.1		38.9
<15 min	0		2.8	2.7		3.7	0		2.8
16–30	21.8		25.0	7.3		15.7	7.3		5.6
31–45	37.3		32.4	40.0		24.1	15.5		9.3
46–60	22.7		16.7	30.0		27.8	19.1		19.4
>60	18.2		7.4	20.0		22.2	19.1		24.1
Wilcoxon *P* value		0.01			0.14			0.83	

The changes in body composition from predeployment to postdeployment in Afghanistan were less than expected based on anecdotal reports. In overfat individuals, weight loss, particularly fat loss, is a positive outcome. Although there was a small decrease in body mass after deployment, the loss was due to a moderate decrease in lean mass and a smaller increase in body fat. The US Army requires all soldiers to meet an age- and sex-adjusted body fat standard if they exceed the weight-for-height standard at the semiannual weigh-in. Although we did not use the standard Army circumference method to estimate percent body fat, the body fat estimate from the DXA output was used to estimate the number of soldiers in compliance with the Army body fat standard predeployment and postdeployment. The DXA, although considered the "gold standard" for body composition, tends to produce a higher estimate of percent body fat than the circumference equation used by the Army (6). Twenty-six percent of the soldiers were overfat for their age group predeployment, whereas 33% were overfat postdeployment, despite the decrease in body weight.

Examination of the fat-free mass quartile results revealed that the greater the quantity of fat-free mass, the greater the loss of fat-free mass from predeployment to postdeployment. The change in fat-free mass from predeployment to postdeployment was significantly correlated with the change in strength training days per week ($r = 0.37$, $P < 0.01$). Soldiers who lost fat-free mass tended to decrease the number of strength training days per week during deployment.

It is more difficult for highly fit individuals to improve fitness during a training program compared with lower fit individuals because they are closer to their maximum potential (10,12,15). Similarly, highly fit individuals might be affected by the deployment to a greater extent if detraining occurs. In general, soldiers in the present study with higher predeployment upper or lower body power, strength, or aerobic fitness tended to demonstrate larger postdeployment decrements than those with lower predeployment fitness. Studies of physical training suggest that these losses will likely be regained within 2–6 wk once appropriate physical training resumes (12,15,20).

A limitation to the data presented is the lack of an independent control group. Ideally, a second sample of soldiers would be deployed for the same length of time with a different activity level. Because the soldiers' combat missions were directed by their commanders, it was not possible for a separate group of soldiers to conduct different missions to control for activity levels. The reported training habits before and during deployment were used as a measure of activity level. The repeated-measures design allowed each soldier to act as his own control.

A second limitation to the study is that exposure to altitude was not standardized. Individual soldiers were distributed across 17 different locations for varying periods of time. Based on the reported locations and the length of stay, the mean altitude for the sample was 1635 ± 519 m, which could be considered moderate altitude. Only nine soldiers (8%) were exposed to high altitude (>2400 m). If predeployment aerobic training habits had been maintained, acclimatization to moderate or high altitude might be expected to produce an increase in peak $\dot{V}O_2$ upon return to sea level due to a residual increase in hemoglobin (4,7). As the opposite was found, the decrease in peak $\dot{V}O_2$ can be mainly attributed to a decreased aerobic training volume. It is possible, however, that the decrease in peak $\dot{V}O_2$ was somewhat masked by the exposure to altitude.

The 9-month deployment to Afghanistan resulted in significant negative effects on aerobic performance, upper body anaerobic power, and body composition; however, lower body anaerobic power and lifting strength were maintained. Soldiers reported decreased self-ratings of physical fitness of 4% to 7% and a decreased frequency of aerobic training. The changes in upper body power and aerobic fitness did not exceed 6%, and it is expected that these losses can be quickly reversed with appropriate

physical training. Current deployments are 15 months rather than the shorter 9-month period examined here, and many soldiers are being deployed multiple times. Extended duration and multiple deployments may have effects that differ from those reported here, and further studies may be necessary to examine these effects and protect the health and military readiness of deployed soldiers.

The soldiers of the 2nd Batallion, 4th Infantry Regiment, 10th Mountain Division, who participated in this study were critical to its success, as were LTC Frank Sturek Commanding, CSM Joseph Montour, MAJ Ronald Eschelberger, MAJ Rafael Paredes, SFC Shawn Sessions, CPT Todd Nash, and 1LT Patrick Glass. The following individuals (listed in alphabetical order) are gratefully acknowledged for the significant contributions made to the technical and scientific aspects of the study: SGT Joseph Alemany, SGT Daniel Catrambone, SGT Darnell Dobbins, Mr. David Gutekunst, Mr. Nathan Hendrickson, Mrs. Sandra Kelly, Mr. Robert Mello, SPC Kevin Rarick and SGT Lisa Trueheart.

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of the US Army, the Department of Defense, or the American College of Sports Medicine.

The investigators have adhered to the policies for protection of human subjects as prescribed in Army Regulation 70-25, and the research was conducted in adherence with the provisions of 32 CFR Part 219.

Human subjects participated in these studies after giving their free and informed voluntary consent. Investigators adhered to AR 70-25 and USAMRMC Regulation 70-25 on the use of volunteers in research.

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